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(54) **Method for the production of windings for inductive components, and corresponding components thus obtained**

(57) The electronic component comprises an electric winding, consisting of a plurality of conductive tracks (24) provided on a laminar support (22; 26) and of a plurality of half-turns (8), the ends of which are connected electrically to said conductive tracks (24) in order to form the winding. A ferro-magnetic core (15) is optionally disposed inside the winding.

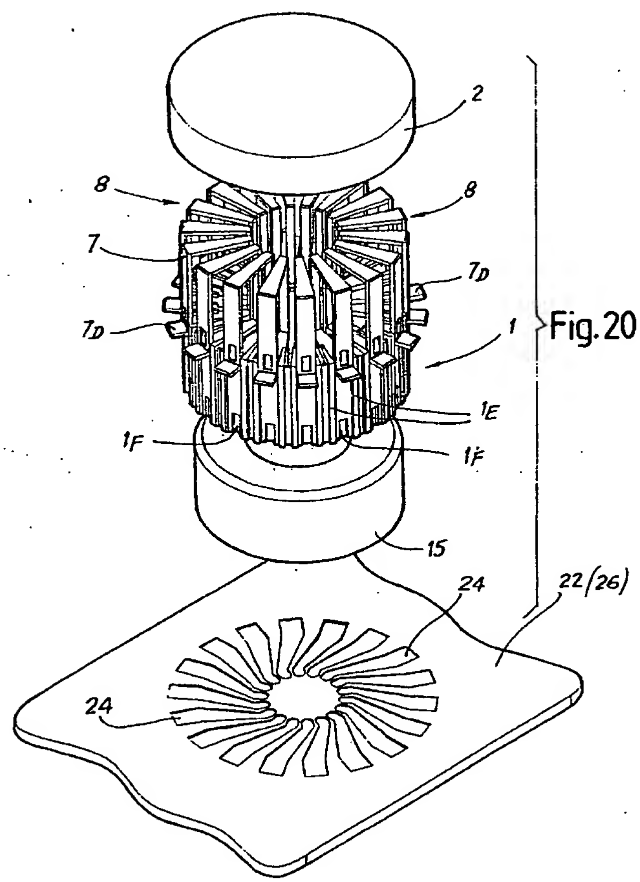

Fig.20

EP 1 071 103 A1

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Description

[0001] The present invention relates to a method for the production of conductive windings for electric and electronic components, such as coils, transformers, simple and multiple inductors, and in general any component which comprises a plurality of turns of conductive material.

[0002] At present, these components are typically produced by winding a copper wire, which is painted with insulating paint, around a ferro-magnetic core. This operation requires extensive labor, and is usually carried out in factories other than those in which the wound component is subsequently used in order to produce electronic circuits. This is in order to be able to use lower-cost labor for this type of processing.

[0003] The present winding technology is very difficult to automate, and also has other disadvantages, caused for example by the need to paint the conductive wire with an insulating paint, by the high level of magnetic flows dispersed, and by the difficulty in disposing of the heat generated inside the component.

[0004] The object of the present invention is to provide a different method for the production of electric windings, which does not have the above-described disadvantages. More specifically, the object of the present invention is to provide a method which lends itself to easy automation of the process of formation of the winding.

[0005] Another object of the present invention is to provide a method which is particularly flexible, and which, with few interventions, makes it possible to produce windings consisting of a variable number of turns, in parallel and/or in series.

[0006] Another object of the present invention is to provide a method which makes it possible to obtain wound components with a low level of dispersion of the magnetic flows.

[0007] An object of the present invention is also to provide a method which makes it possible to produce components from which it is particularly easy to dispose of the heat dissipated, and which do not cause problems owing to the need to insulate the individual turns electrically.

[0008] This and other objects and advantages, which will become apparent to persons skilled in the art by reading the following text, are obtained substantially by means of a method comprising the steps of:

- producing a plurality of conductive tracks on a laminar support; and
- connecting to said conductive tracks a plurality of half-turns made of electrically conductive material, said half-turns having ends which are electrically connected to said conductive tracks, the half-turns and the conductive tracks forming said electric winding.

[0009] In general, this method can be implemented by mounting the various half-turns individually on the laminar support on which the conductive tracks have been produced, for example by means of a standard machine of the type used for the mounting of SMD components. In this case, onto specific surfaces of the conductive tracks, there is applied a soldering paste, and the various half-turns are applied temporarily on the latter. Subsequently, on completion of the temporary application of the half-turns, which are retained by an adhesive effect of the soldering paste itself, the laminar support undergoes the soldering step, optionally after other components have been fitted onto the support itself. Before mounting the individual half-turns, onto the- laminar support there can be secured a ferro-magnetic core, which will then become arranged inside a volume surrounded by the half-turns, which form a kind of cage around the ferro-magnetic core itself.

[0010] This form of implementation of the method according to the invention is particularly advantageous, since it reduces to a minimum the passages of the production cycle. However, it means that the half-turns must have dimensions and a shape such as to provide them with sufficient stability during the assembly step, both during the temporary application and in the subsequent soldering operation, which shall not give rise to excessive spatial displacements of the half-turns, or anyhow the displacements must be compatible with the distances of said half-turns relative to one another, such that the latter do not come into contact with one another.

[0011] When these conditions cannot be met, or when, for any reason, it is preferable to assemble the half-turns in a preliminary step, and then apply them simultaneously onto the laminar support which is provided with the conductive tracks, the half-turns can be applied onto a support structure; and subsequently, the half-turns, which are integral with the support structure, can be applied to the conductive tracks provided on the laminar support.

[0012] According to a possible embodiment of the invention, the support structure consists of a laminar component on which there are made to adhere said half-turns, which have an intermediate portion which is made to adhere to said laminar component, and two portions which are substantially at right angles to said laminar component.

[0013] According to an alternative embodiment of the method according to the invention, the support structure forms a container made of electrically insulating material, which has an inner space and an edge adjacent to said inner space. In addition, there is application to said container of the half-turns of conductive material, which have ends adjacent to said edge. Finally, the container is applied to the laminar support which provided with the conductive tracks, with the ends of said half-turns electrically connected to said conductive tracks themselves. In this case, the half-turns can also be produced by depositing a metallization layer- on the container which forms the support structure.

[0014] The half-turns substantially constitute open conductive components, the ends of which can be connected to one another electrically in various ways, in order to obtain a variable number of turns in series and/or in parallel, as described in greater detail hereinafter with reference to an embodiment. By means of this method, an intermediate component is obtained, consisting of a container and of the corresponding half-turns, which has a very low cost, can be produced by means of an automated production cycle, and, depending on how the ends of the individual half-turns are connected to one another, can provide an inductive component with variable characteristics. As one extreme, the individual half-turns can be connected to one another in series in order to form a single winding, comprising a number of turns which corresponds to the number of half-turns. Alternatively, all the half-turns can be closed on themselves, and in parallel with one another, in order to form a single turn. Between these two extreme solutions, respectively for low and high currents, all the intermediate configurations can be obtained.

[0015] The half-turns can be made of conductive metal plate, or deposited by means of a galvanic process, and subsequent photoengraving or the like. In both cases, turns with a flat development are obtained, with a high capacity for dissipation of the heat. In both cases, the application of the half-turns to the container can easily be mechanized.

[0016] Further advantageous features of the method according to the invention are described in the attached claims.

[0017] The object of the invention is also an electronic component with at least one winding, in which the electric winding consists of a plurality of conductive tracks provided on a laminar support and of a plurality of half-turns, the ends of which are connected electrically to said conductive tracks in order to form said winding.

[0018] According to a practical embodiment, the half-turns consist of shaped conductive plate, for example in order to impart to the individual half-turns the shape of a U. The various half-turns can be applied individually to the conductive tracks. According to a possible embodiment of the invention, however, the various half-turns are supported by a common support structure, which can consist of a laminar support component, which for example has a flat development, onto which the individual half turns are soldered or connected by another means.

[0019] According to a variant of this embodiment, the support structure consists of a container with a space to accommodate an optional ferro-magnetic core, along which space an edge extends. In this case, the half-turns of conductive material extend around said space, and have ends at said edge. A component of this type constitutes a finished product for persons who produce the assembly consisting of the container and the half-turns, and a semi-finished product for manufacturers of circuits, who, starting from the container with the half-turns applied to it, produce the electronic components and the circuits in which the latter are inserted, optionally inserting in the container one or a plurality of ferro-magnetic cores.

[0020] The component can also have more than one series of half-turns in order to constitute more than two windings. Alternatively, or in association, a further winding can be produced on a ferro-magnetic core which is subsequently inserted in the container. By this means, it is possible to produce transformers, or even multiple inductances, which are wound on a single ferro-magnetic core.

[0021] Further advantageous features of the electronic component according to the invention are described in the attached dependent claims.

[0022] The invention will be better understood by means of the following description and the attached drawing, which shows non-limiting embodiments of the invention. More specifically, in the drawing:

Fig. 1 is a container made of insulating material, for production of wound components, in a cross section along a plane which contains the axis of the container;
Fig. 2 is a plan view according to II-II in Fig. 1;
Fig. 3 is a plan view of a conductive sheet, with the half-turns disposed on it for subsequent application;
Fig. 3A is a development in plan view of an individual segment which forms a half-turn;
Fig. 4 is a longitudinal cross section of the container with the half-turns formed on it;
Figs 4A and 4B are an enlarged detail of Fig. 4 in two embodiments;
Fig. 5 is an axonometric view of the container in Fig. 4 with the half-turns applied;
Figs 6 and 7 are a view from below and a view from above according to VI-VI and VII-VII respectively in Fig. 5;
Fig. 8 is a longitudinal cross section of the container, with the ferro-magnetic core inserted in it, and prepared for application on a printed circuit;
Fig. 9 is a partial schematic plan view according to IX-IX in Fig. 8, of the printed circuit;
Figs 10 and 11 are two cross sections similar to the cross section in Fig. 8, in two variant embodiments;
Fig. 12 is a cross section similar to the cross section in Fig. 4, in a variant embodiment;
Fig. 13 is a front view of an intermediate support for mounting at right angles to the board which supports the printed circuit;
Fig. 14 is a perspective view of the support in Fig. 13, with a container mounted on it;
Fig. 15 is an exploded perspective view of an improved component according to the invention;
Fig. 16 is a perspective view of an assembly of half-turns in a rectilinear arrangement;
Fig. 17 is a lateral view, partially in cross section, of a half-turn of the assembly in Fig. 16;

Figs 18 and 19 are perspective views from above and from below of an improved container according to the invention;

Fig. 20 is an exploded perspective view of a component produced by means of the container in Figs 18 and 19;

Fig. 21 is a plan view of a support structure with laminar development for a different embodiment of the invention;

Fig. 22 is an axonometric view of an individual half-turn to be applied to the laminar support component in Fig. 21;

Fig. 23 is a plan view according to line XXIII-XXIII in Fig. 24 of the laminar support component in Fig. 21 with the half turns mounted;

Fig. 24 is a cross section according to XXIV-XXIV in Fig. 23;

Fig. 25 is a cross section similar to the cross section in Fig. 24, with a ferro-magnetic core inserted in the inner space formed by the half-turns;

Figs 26 and 27 are plan views of the two surfaces of a laminar support provided with the conductive tracks onto which the half-turns are soldered;

Fig. 28 is a cross section similar to the cross section in Fig. 25, with the laminar support mounted;

Fig. 29 is a plan view similar to the view in Fig. 23, with a ferro-magnetic core provided with a wire winding inserted in the space defined by the half-turns; and

Fig. 30 is a cross section similar to the cross section in Fig. 28, with a ferro-magnetic core provided with a wire winding for the production of a transformer.

[0023] Fig. 1 shows in longitudinal cross section a container 1, made of electrically insulating material, for example a synthetic resin, which is preferably thermally conductive. The container extends annularly, since it is designed for the production of a toroidal winding. However, this shape is non-limiting, and as will become more apparent hereinafter, the same inventive concept can be applied to containers and windings with various shapes.

[0024] The container 1 has an inner space 3, which is open at the base, and a central through hole 5. Around the outer surface of the container there is applied a plurality of half-turns, i.e. open turns, which are made of an electrically conductive laminar material, for example from a copper sheet, of a thickness suitable for the current which must flow in the turns, for example a thickness of between 0.1 and 3 mm. Fig. 3 shows a development in plan view of a sheet of conductive material cut such as to form a series of shaped segments 7 (twenty-four in the example illustrated) disposed in the shape of a dial, each connected at the outer radial end to a ring 9, and at the inner radial end to a ring 11. Each segment 7 (see Fig. 3A) consists of a first rectangular portion 7A with a length H+S, a second trapezoidal intermediate portion 7B with a height D, and a third rectangular portion 7C, with a width smaller than the portion 7A, but with the same length (H+S). The dimensions H and D correspond respectively to the height of the container 1 and the to difference between the outer diameter of the latter and the inner diameter of the through hole 5, as can be seen in Fig. 4.

[0025] The assembly of segments 7 is applied around the container 1, by folding at a right angle the portions 7A and 7C relative to the intermediate portion 7B, such as to obtain around the container 1 an arrangement of half-turns in the shape of a "U", as can be seen in Fig. 4, and indicated as 8 in the latter. By means of this operation, which can be carried out by means of a punch tool, the rings 9 and 11 are detached from the segments 7, and removed. The turns 8 formed by the folded segments 7 are stabilized on the container 1 by means of suitable resin bonding. The resin bonding can be carried out before completing punching of the ring 11, such as to retain the segments 7 in the correct position around the container 1. Each half-turn comprises two rectangular portions which extend parallel to the axis A-A of the container 1, and are defined by the portions 7A and 7C of the respective segments 7, and a trapezoidal intermediate portion, consisting of the portion 7B of the segment 7, which extends radially on the upper surface of the container 1. Since the portions 7A and 7B of the segments 7 have a length which is longer (by an amount S) than the height H of the container 1, each half-turn 8 formed by the segments 7 projects relative to the lower edge 1A of the container 1 by an amount S, and can be folded as shown in detail in Fig. 4A, against this edge 1A, or toward the exterior, as shown in Fig. 4B.

[0026] As already stated, the assembly of the turns 8 is resin-bonded onto the container 1, in order to obtain stability. The resin bonding is not shown in the attached drawings, for greater clarity of representation. The container thus obtained is shown in Figs 5 to 7.

[0027] The container 1 with the half-turns 8 can be used to produce a component wound in the air, in which case the inner space 3 remains empty, or to produce an inductive component, for example a coil, by introducing into the space 3 of the container 1 a ferro-magnetic core 15 (see Fig. 8). The ferro-magnetic core is glued by means of a layer of synthetic resin 17 applied to the base of the space 3, as shown in Fig. 8. As an alternative, the ferro-magnetic core 15 can be embedded inside the container 1, for example by providing a projection along the edges of the space itself, into which the core is snapped.

[0028] The component thus obtained, which is generally indicated as 21, can be applied to a printed circuit produced on a support and indicated schematically as 22. On the support on which the printed circuit is produced, there are provided welding pads, which are of a number equivalent to twice that of the half-turns 8, and are disposed according to two circular alignments, corresponding to the alignments of the ends of the half-turns 8. The arrangement of the welding pads can be

seen in particular in Fig. 9, where the individual pads are indicated as 23 (outer alignment) and 25 (inner alignment).

[0029] The individual pads 23, 25 are connected to one another electrically by means of suitably arranged conductive tracks, according to the type of connection to be obtained between the turns. For example, in the left part of Fig. 9, there are shown in broken outline three connection tracks 24A, 24B, 24C, between the pads indicated as 23A, 23B, 23C, 25B, 25C, 25D. More specifically, the tracks 24A, 24B, 24C connect to one another in pairs the pads 23A-25B, 23B-25C, 23C-25D. When the component 21 is applied to the circuit produced on the board 22, the pads 23, 25 are connected to one another by individual turns 8 with homologous pairs, i.e.: 23A-25A, 23B-25B, 23C-25C, 23D-25D. By this means, the tracks 24A, 24B, 24C join the half-turns 8 which are connected to the pads 23A-23D and 25A-25D in series, forming a single winding of three complete turns in series. In the right-hand part of Fig. 9, there are illustrated pads 23X, 23Y, 23Z and 25X, 25Y, 25Z, which are connected by tracks 24X, 24Y, 24Z, such as to form, with three half-turns 8 applied to the pads 23X-25X, 23Y-25Y and 23Z-25Z, three complete turns which can be connected in parallel. The half-turns 8 are connected by their own ends to homologous pads (23X, 25X; 23Y, 25Y; 23Z, 25Z).

[0030] The connection between the ends of the half-turns 8 and the pads 23, 25 takes place by soldering, by remelting, or by another equivalent means.

[0031] By means of this arrangement, by arranging the conductive tracks 24 in an appropriate manner on the board 22, it is possible to produce windings with any arrangement (series and/or parallel) of the twenty-four half-turns 8 of the component 21. With a single standard component, which consists of the container 1 and the half-turns 8 applied to the latter, it is thus possible to produce components 21 of various types. The arrangement of the conductive tracks 24 is selected on the basis of the number of turns and/or the current which must flow in them.

[0032] Fig. 10 shows a cross section similar to Fig. 8, in which the ends of the half-turns 8 produced on the component 21 are not folded against the edge 1A of the inner space of the container 1, but continue to project from the latter, in order to pass through through holes which are provided in the board 22. In this case, the connection between the ends of the half-turns 8 is again provided by means of tracks produced on the board 22, but the soldering takes place for example in wave form, by operating on the side opposite the side of application of the component 1.

[0033] Fig. 11 shows by way of example a component 21 of a different kind. Whereas in the previous cases the component 21 substantially consisted of an inductance formed by a single winding, consisting of the half-turns 8 closed by the conductive tracks 24, in Fig. 11 the component 21 constitutes a transformer, in which the half-turns 8 form the secondary winding, whereas the primary winding consists of a single, insulated metal wire 31, which for example is made of painted copper, wound around the core 15. Alternatively, both the primary and secondary winding can consist of half-turns 8, which are disposed on two superimposed layers, which are separated by a resin.

[0034] Fig. 12 shows a different embodiment of the container 1 and the half-turns 8. In this case, the container 1 consists of synthetic resin, which has been injected into a mold, in which there have previously been positioned the half-turns 8, which are thus incorporated in the material which forms the container 1. In this embodiment, a second series of half-turns can easily be applied on the container 1, by means of the technique previously described, in order to form two windings around the space 3 of the container 1, inside which the ferro-magnetic core is subsequently inserted.

[0035] As initially stated, the toroidal shape of the ferro-magnetic core and the container 1 are not compulsory, since the above-described inventive concept can also be produced by means of cores in the shape of an "E+E", "C+C", or with another geometry. According to the shape of the core, it is also possible to use several containers instead of a single container such as that indicated as 1. In this case, there are provided on the ferro-magnetic core a plurality of containers of various shapes, each of which supports the corresponding half-turns. The container can also consist of a section in the shape of a "U", which is open at the ends, and which, when combined with the adjacent containers, forms a seat to contain the ferro-magnetic core.

[0036] In the preceding description, it is assumed that the individual half-turns are produced by punching from a laminar sheet of conductive material, for example copper, in order to obtain a semi-finished product of the type illustrated in Fig. 3, which is subsequently shaped, and from which the joining rings 9 and 11 are removed. However, alternatively, it is possible to produce the individual half-turns 8, which are then applied one by one to the container 1, for example by means of an assembly robot. For example, individual segments 7 can be produced by punching from a copper sheet, and then folded into the shape of a "U", in order then to be disposed on the container 1. Again as an alternative, the individual segments 7 can be produced from a strip of conductive material, and subsequently detached individually, folded, and applied to the container. In this case, strips of punched material form a type of loader for half-turns.

[0037] Similar advantages can be obtained (in particular when the thickness required for the half-turns 8 is small) by producing the half-turns by galvanic or silk-screen addition, or the like, of a layer of conductive material onto the outer surface of the container 1, and subsequent photoengraving. In this case, half-turns are obtained which have a very small thickness, but are stably applied to the container 1, without requiring resin bonding.

[0038] According to the above-described method, the component 21 is applied horizontally onto the printed circuit. In practice, this solution cannot always be implemented for reasons of space. In this case, the soldering pads 23, 25 and the connection tracks 24 can be provided on an intermediate support, to close and support the component 21. The intermediate support, which has a flat shape, is then applied at right angles to the board 22. In both cases, the container 1 is applied to a laminar support (which can be the board on which the printed circuit is provided, or the intermediate support for closure and support). In this case also, the main advantages of the present invention are obtained. In the case of application of the horizontal component 21 onto the printed circuit, the printed circuit itself can be produced with the conductive tracks 24 disposed according to requirements, in order to connect the various half-turns 8 appropriately. On the other hand, in the case of use of an intermediate support for closure and support, the latter can be produced in various versions, with conductive tracks 24 for connection between the soldering pads 23, 25, disposed according to various series/parallel configurations. By combining an intermediate support and a component 21 with the respective half-turns 8, it is possible to obtain reciprocal closure and connection of the turns according to the specific design requirements.

[0039] Figs 13 and 14 show an embodiment of an intermediate support 26 with soldering pads 24 and contacts 28, to be applied to the printed circuit, in order to form a mechanical and electrical connection. In Fig. 13, the intermediate support 26 is shown in isolation, whereas Fig. 14 also shows the container 1 mounted on the latter.

[0040] Fig. 15 shows an exploded view of an electronic component produced according to the invention, in a slightly modified form. In this case, the container 1 has on its outer cylindrical surface longitudinal grooves 1X, which form seats to accommodate the half-turns 8. The latter have terminal ends which are folded in a direction pointing away from the inner space of the container 1, unlike the type shown in the previous embodiments. 15 indicates the ferro-magnetic core inserted in the inner space 3 of the container 1, and 22 indicates the board which supports the printed circuit, where the conductive tracks 24 are provided. The half-turns 8 are stably connected to the container 1 by means of a cover 2 which is punched out and inserted above the half-turns 8, when the latter have been inserted in the individual seats formed by the grooves 1X. As an alternative, in this case also, the half-turns can be secured by resin bonding.

[0041] Figs 16 and 17 show a different embodiment of the segments 7 which form the half-turns 8. In this embodiment, the segments 7 are produced by punching and folding a rectangular latten, and are temporarily connected to one another by means of a longitudinal strip of latten 32 at the rupture points 33. References 7A, 7B and 7C again indicate the portions which form each individual segment 7, whereas 7D and 7E indicate the folded terminal ends of the segments themselves. In this case, the folding is carried out in the direction pointing away from the space 3, around which the half-turns 8 which consist of the segments 7 are applied. This simplifies the subsequent soldering, in comparison with the previous embodiment. In the example illustrated, each segment 7 (Fig. 17) has at the portion 7A a resilient retention tab 7F, which is produced by punching, the function of which is described hereinafter.

[0042] The strip of aligned segments 7 shown in Fig. 16 can be used as a loader for components in an assembly robot, which then inserts each individual segment 7 which forms the corresponding half-turn 8 on the container 1.

[0043] The segments 7 in Figs 16 and 17 are produced for use in association with a container 1, which is produced as shown in Figs 18 to 20. In this embodiment, the container 1 has a configuration in the form of panels 1 B, which are connected to one another by joining portions 1C with a reduced thickness. At a radial plane, the container has a notch 1 D, which corresponds to the absence of one of the joining portions 1C. The container 1 can thus be produced in linear form, and then folded on itself in order to bring it into the annular shape shown in Figs 18 and 19, with the two end panels 1 B abutting at the notch 1 D.

[0044] Each panel 1 B has a development which corresponds approximately to the development of the segments 7, with two lateral ribs 1 E, which extend along the lateral cylindrical wall, and partially along the flat front wall of the container (see in particular Fig. 18). The lateral ribs 1E form retention seats for the segments 7 which form the half-turns 8. In addition, each panel 1 B has a recess 1 F in the vicinity of the lower edge 1 A, for the purposes described hereinafter.

[0045] The exploded view in Fig. 20 illustrates the method of assembly of the component produced with the segments 7 in Figs 16 and 17, and with the container in Figs 18 and 19. The segments 7 which form the half-turns are inserted individually in the seats delimited by the lateral ribs 1 E of each panel 1B which forms the container 1, and the tabs 7F are inserted in the corresponding recesses 1F. By this means, each half-turn 8 formed by the respective segment 7 remains correctly in its own position. A cover 2, or corresponding resin bonding, is used in this case also, in order to stabilize the half-turns on the container 1. Reference 15 indicates the ferro-magnetic core, and reference 22 indicates the board (or, alternatively, 26 indicates the intermediate support for vertical mounting, with the conductive tracks 24 which complete the turns, and are soldered to the ends of the segments 7).

[0046] Figs 21 to 30 show a further series of variant embodiments of the invention. According to this embodiment, the half-turns 8 are no longer mounted on a container 1, which forms the support structure for the half-turns. In this case, the support structure consists of a

simple disk-shaped laminar support component, which is indicated as 101. The laminar component 101 has a central hole 101A, which is partly occupied by a detachable plate, which is used simply to facilitate handling of the component 101 during assembly.

[0047] On one surface of the support component 101, there are applied half-turns 8, which have the shape which can be seen in particular in Fig. 22, in which identical numbers indicate parts which are the same as those in the embodiments already described. The segments which form the half-turns 8 are glued or soldered to the laminar support component 101. The glue can be applied in spots, or using the silk-screen process, in order to obtain the required distribution. If soldering is used, the soldering paste can be applied to a metallization layer previously applied to the surface of the laminar support component 101. The latter can be produced from electrically insulating material, or also from electrically conductive material, provided that it has an insulating layer, in order to prevent it from short-circuiting the half-turns. In the latter case, excellent thermal transmission is obtained, and thus easy disposal of the heat dissipated by the component, as described in greater detail hereinafter.

[0048] Inside the space defined by the branches of the "U" formed by the half-turns 8, there is optionally inserted a ferro-magnetic core, which is again indicated as 15, as shown in Fig. 25. The ferro-magnetic core can be secured, for example by means of an adhesive, in the space formed by the half-turns. Since a container made of insulating material is not provided, in order to prevent electrical contact between the half-turns and the ferromagnetic core 15, the latter can be painted with an insulating paint. This painting can be omitted if the ferromagnetic material of the core 15 has sufficiently low electrical conductivity.

[0049] The assembly thus obtained is mounted on a laminar support, which is again indicated as 26 (Figs 26, 27, 28), similar to that in Figs 13 and 14, in which there are provided conductive tracks 24. On both surfaces of the laminar support 26, there are provided two contacts 24A, 24B respectively, which constitute the electrical and mechanical connections for vertical mounting of the support 26 on an electronic board. As an alternative, the assembly in Fig. 25 can be mounted horizontally, directly on the electronic board, in which case the conductive tracks 24 are produced directly on the latter.

[0050] Fig. 28 shows the complete component, with resin bonding, which encloses the internal components. As can be seen in the cross section in Fig. 28, the component has an axial hole, corresponding to the hole 101A in the laminar support component 101. This axial hole allows a thermal dissipator to be assembled by being screwed onto that surface of the component which is opposite the laminar support 26. By means of this arrangement, the half-turns (8), the laminar support component 101, and optionally the thermal dissipator which is applied to the latter, permit efficient extraction of the heat generated inside the component, and dispersal of the heat toward the environment.

[0051] Figs 29 and 30 show the same component as Fig. 28 (which in Fig. 29 is in an intermediate assembly step, before application of the laminar support 26), in which, around the ferro-magnetic core 15, a winding has been applied, which for example is made of painted wire, similar to the winding 31 in Fig. 11, and in this case also is indicated as 31.

[0052] It will be appreciated that the drawing shows only practical embodiments of the invention, the shapes and arrangements of which can be varied without thereby departing from the basic concept of the invention. The presence of any reference numbers in the attached claims is intended only to facilitate reading thereof in the light of the description and drawings, and does not limit their scope of protection.

Claims

1. A method for the production of a component, comprising at least one electric winding, consisting of one or a plurality of turns, characterized by the steps of:

   - producing a plurality of conductive tracks (24) on a laminar support (22; 26); and
   - connecting to said conductive tracks a plurality of half-turns (8) made of electrically conductive material, said half-turns having ends which are electrically connected to said conductive tracks, the half-turns (8) and the conductive tracks forming said electric winding.

2. Method according to Claim 1, characterized in that said half-turns (8) are applied to a support structure (1; 101); and subsequently, said half-turns, which are integral with said support structure, are applied to the conductive tracks (24) produced on said laminar support (22; 26).

3. Method according to Claim 2, characterized in that said support structure (101) consists of a laminar component (101), to which there are applied said half-turns (8), which have an intermediate portion (7B) which is made to adhere to said laminar component, and two portions (7A, 7C) which are substantially at right angles to said laminar component (101).

4. Method according to Claim 2, characterized in that:

   - said support structure (1) forms a container (1) made of electrically insulating material, which has an inner space (3) and an edge (1A) adjacent to said inner space;
   - said half-turns of conductive material (8), which

have ends adjacent to said edge, are applied to said container (1);

- said container (1) is applied to said laminar support (22; 26), with the ends of said half-turns (8) electrically connected to said conductive tracks (24), said conductive tracks (24) and said half-turns (8) forming turns which are wound around the inner space (3).

5. Method according to one or more of the preceding claims, characterized in that a ferro-magnetic core (15) is inserted inside a space defined by said half-turns (8), said winding surrounding the ferro-magnetic core (15).

6. Method according to Claim 4, characterized in that said half-turns extend in the shape of a "U", and surround the base of the container (1) and the lateral walls of the latter.

7. Method according to one or more of the preceding claims, characterized in that said half-turns consist of electrically-conductive plate material.

8. Method according to Claim 4 and Claim 7, characterized in that said half-turns (8) are inserted in a mold, in which said container (1) is produced by injection, the half-turns remaining incorporated in the material which forms said container (1), and projecting from the latter at the edge (1A) of the inner space (3) of said container (1).

9. Method according to Claim 4 and Claim 7, characterized in that said half-turns are applied to the exterior of said container (1), and are stabilized on the latter.

10. Method according to Claim 9, characterized in that said half-turns are locked on said container (1) by resin bonding, or by means of a cover (2).

11. Method according to one or more of Claims 8 to 10, characterized in that the ends of said half-turns are folded on a surface which contains the edge (1 A) of said container (1).

12. Method according to one or more of Claims 9 to 11, characterized in that a series of segments (7) which are connected to one another (9, 11) are punched from a conductive laminar material, and the punched laminar material is preformed on the container (1), while separating said segments (7) from one another.

13. Method according to one or more of Claims 8 to 11, characterized in that the single segments (7) are applied in sequence onto said container (1).

14. Method according to Claim 4 or Claim 6, characterized in that said half-turns are produced by adding electrically conductive material to the outer surface of said container (1), and removing said electrically conductive addition from around the areas which form the half-turns.

15. Method according to Claim 14, characterized in that said addition of electrically conductive material is photoengraved.

16. Method according to at least Claim 5, characterized in that a winding (31) is produced around said ferromagnetic core (15), before it is inserted in said space (3) in order to produce a transformer.

17. An electronic component comprising an electric winding, characterized in that said electric winding consists of a plurality of conductive tracks (24) provided on a laminar support (22; 26) and of a plurality of half-turns (8), the ends of which are connected electrically to said conductive tracks (24) in order to form said winding.

18. Electronic component according to Claim 17, characterized in that said half-turns are integral with a support structure (1; 101).

19. Electronic component according to Claim 17 or Claim 18, characterized in that said half-turns consist of conductive segments (7).

20. Electronic component according to Claim 19, characterized in that said segments extend in the shape of a "U", which surrounds a volume (3) inside said winding.

21. Electronic component according to Claim 20, characterized in that inside said inner volume (3) a ferromagnetic core (15) is accommodated.

22. Electronic component according to at least Claims 18 and 19, characterized in that said support structure (101) consists of a laminar component, to which there are applied said segments (8), and in that said segments project from said laminar support component (101).

23. Electronic component according to Claim 22, characterized in that said laminar support component (101) is made of thermally conductive material.

24. Electronic component according to Claim 22 or 23, characterized in that said laminar support component (101) has a central hole (101A) to secure heat-dissipation components onto said laminar support component.

25. Electronic component according to one or more of Claims 17 to 21, characterized in that: said support structure consists of a container (1) which comprises an inner space (3), along which space there extends an edge (1A); and said half-turns (8) of conductive material extend around said space (3), and have ends at said edge (1A).

26. Electronic component according to Claims 19 and 25, characterized in that said container (1) has seats (1X; 1E) to accommodate the segments (7) which form said half-turns (8).

27. Electronic component according to Claim 25 or 26, characterized in that said container (1) has recesses (1F) in which there are engaged resilient retention tabs (7F) for the segments (7).

28. Electronic component according to one or more of Claims 25 to 27, characterized in that said container (1) is produced from panels (1B), which are connected to one another by joining portions (1C).

29. Electronic component according to Claims 26 and 28, characterized in that each panel (1B) into which said container (1) is subdivided has a respective seat to accommodate a corresponding half-turn (8).

30. Electronic component according to Claim 28 or 29, characterized in that said container extends annularly, and is interrupted along a radial plane (1D).

31. Electronic component according to Claim 25, characterized in that said half-turns (8) are incorporated inside the material which constitutes the container (1), and project from the latter at said edge (1A).

32. Electronic component according to one or more of Claims 25 to 30, characterized in that said half-turns are applied to the exterior of said container, and are stabilized there by resin bonding.

33. Electronic component according to one or more of Claims 25 to 30, characterized in that said half-turns are stabilized by means of a cover (2) which is applied above the latter, on the container (1).

34. Electronic component according to Claim 25, characterized in that said half-turns consist of material which is added galvanically to said container.

35. Electronic component according to one or more of Claims 25 to 34, characterized in that said container (1) consists of thermally conductive material.

36. Electronic component according to at least Claim 21, characterized in that around said ferro-magnetic core (15) there is wound a conductive filament (31) which forms a winding.

37. Electronic component according to one or more of Claims 17 to 36, characterized in that said laminar support (26) has components (28) for electrical and mechanical connection to a board which contains a printed circuit.

38. Electronic board comprising a printed circuit and at least one electronic component according to one or more of Claims 17 to 37.

39. Electronic board according to Claim 38, characterized in that it comprises conductive tracks (24), which connect the ends of the half-turns (8), said half-turns (8) and said conductive tracks (24) forming turns of a winding.

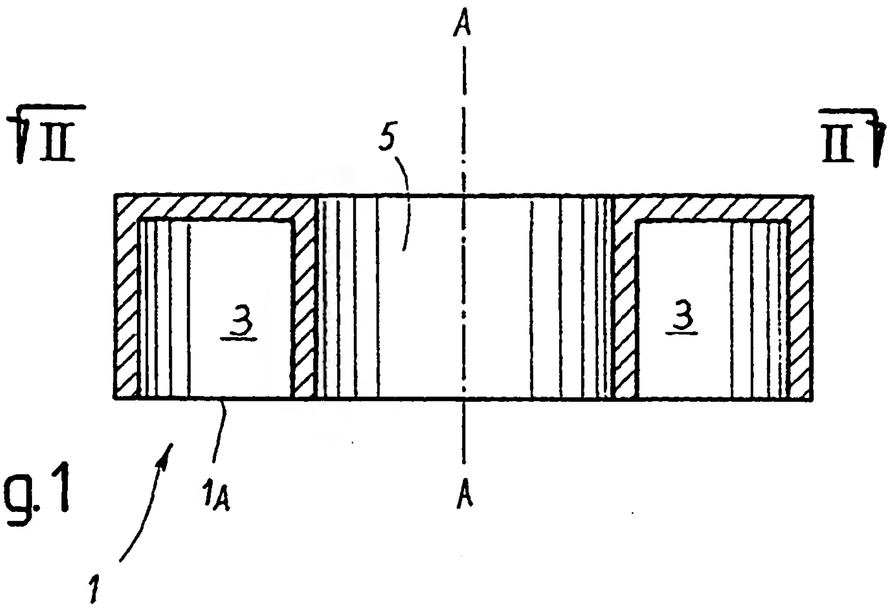


Fig.1

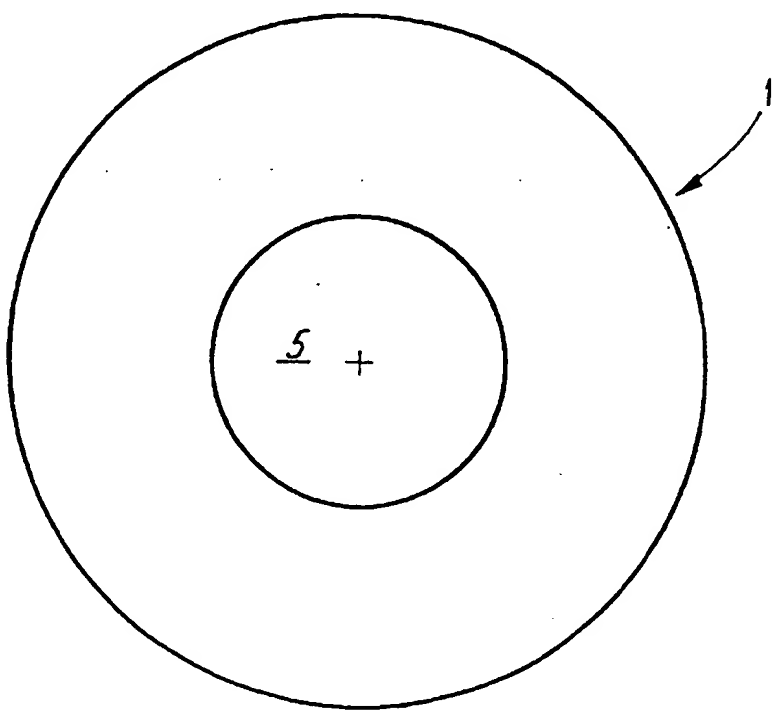


Fig.2

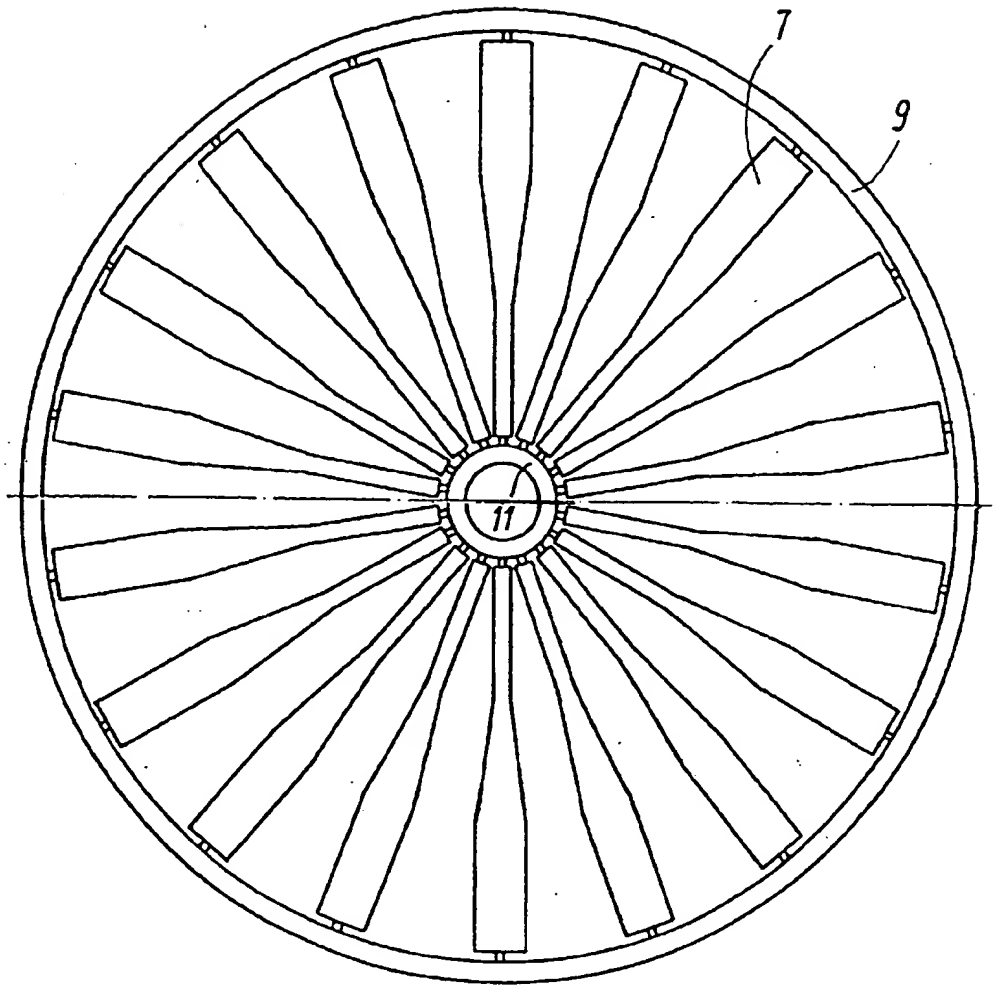


Fig.3

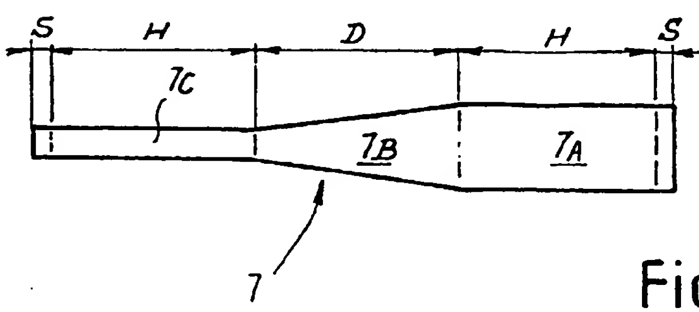


Fig. 3A

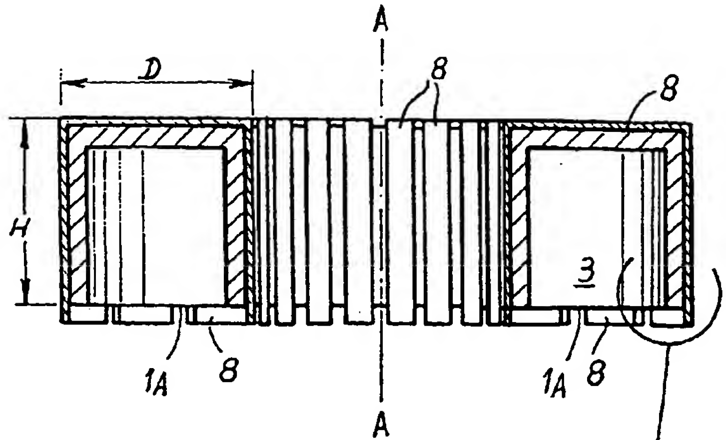


Fig.4

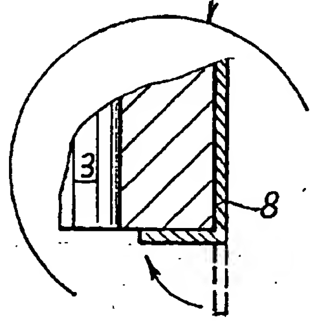


Fig.4A

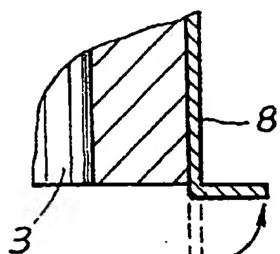


Fig.4B

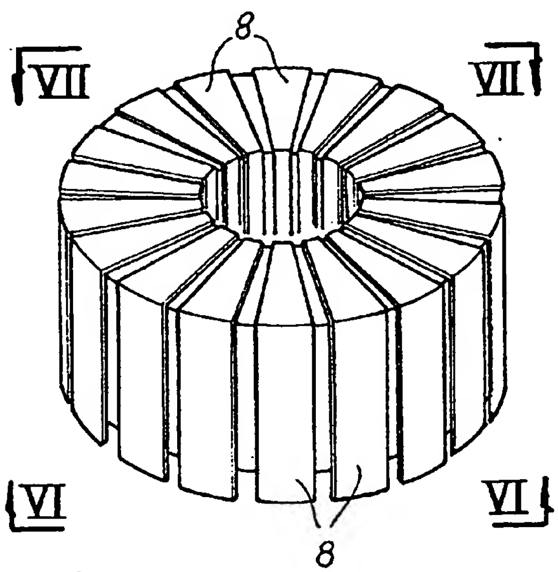
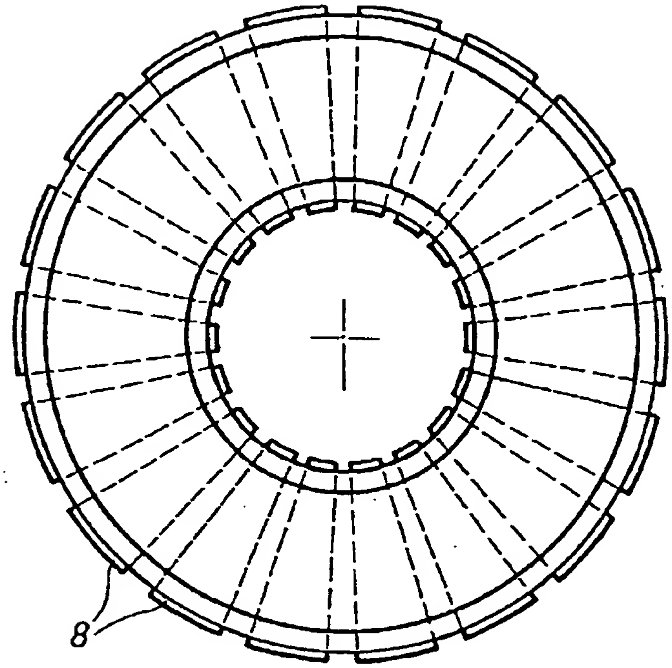


Fig.5



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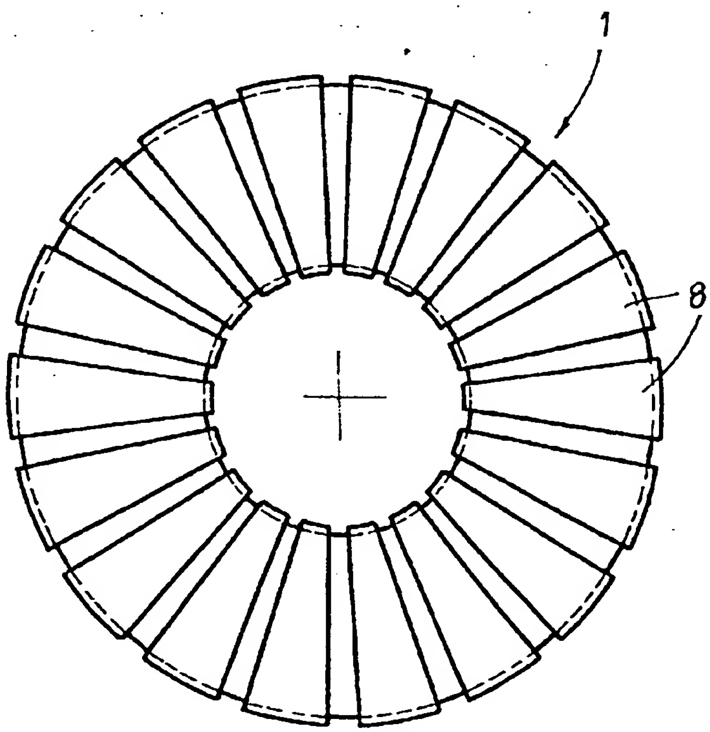
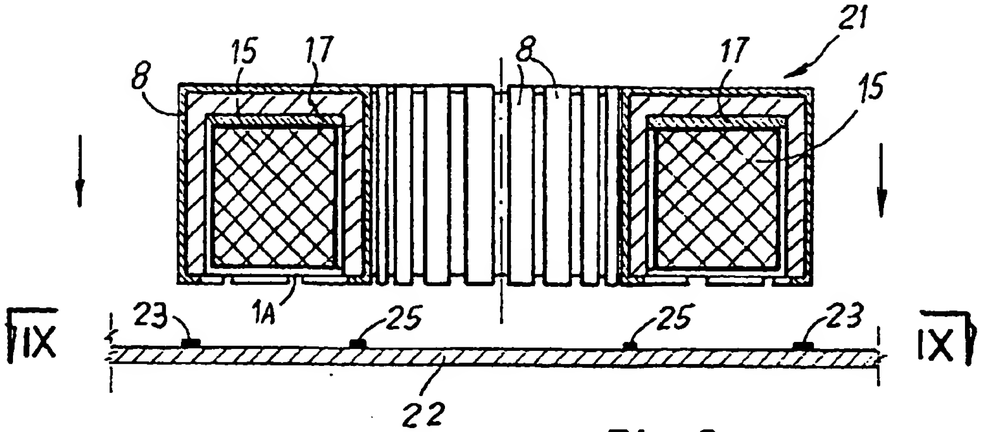


Fig. 7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IX
IX
22

Fig.8

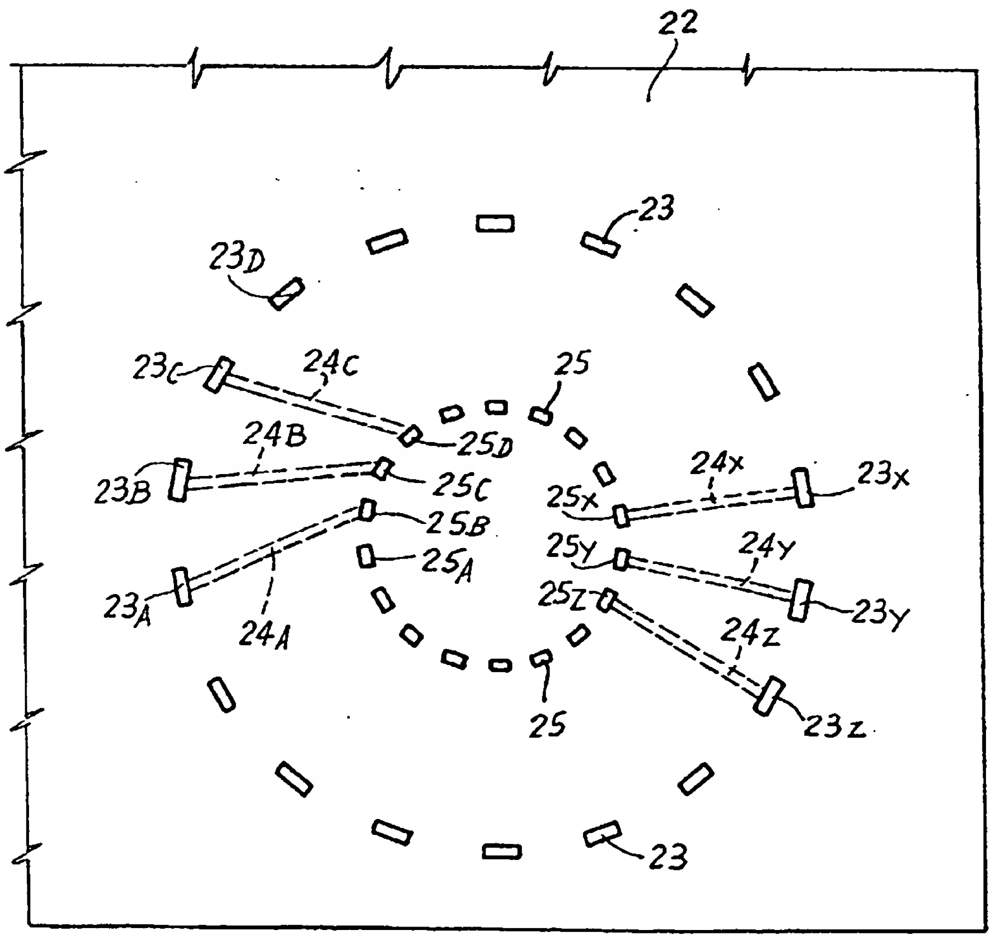
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Fig.9

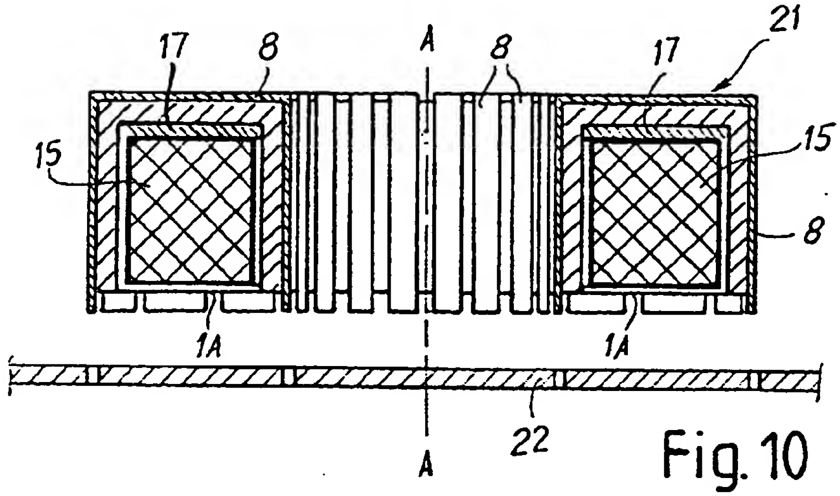
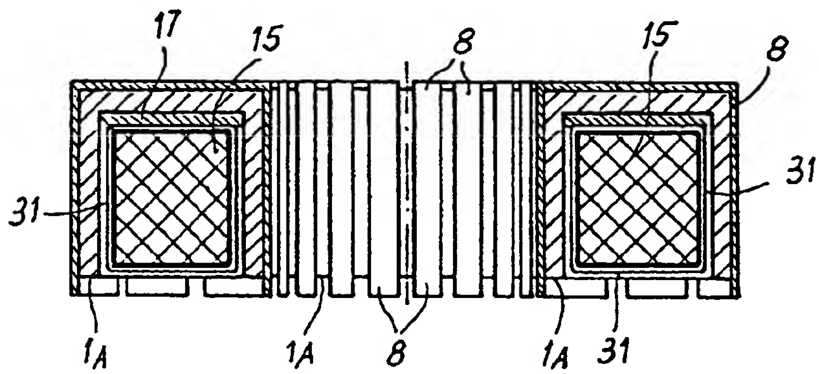


Fig. 10



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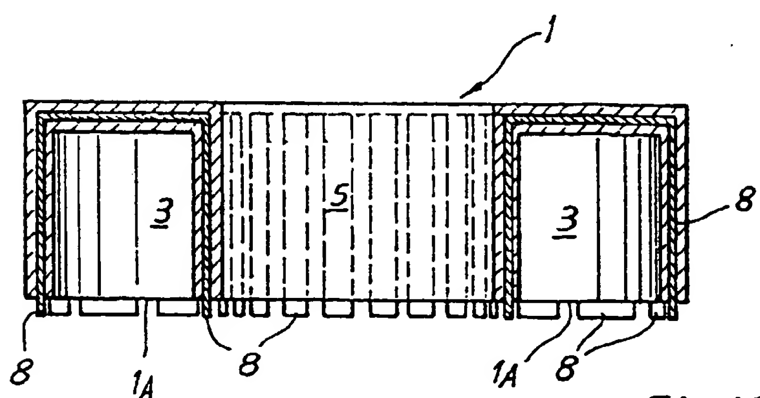

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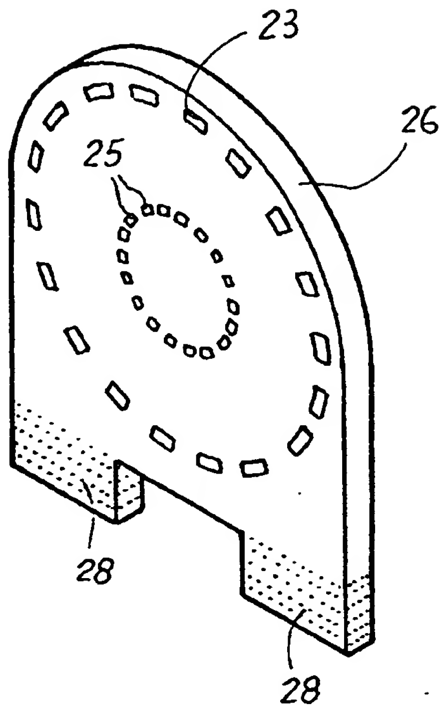


Fig.13

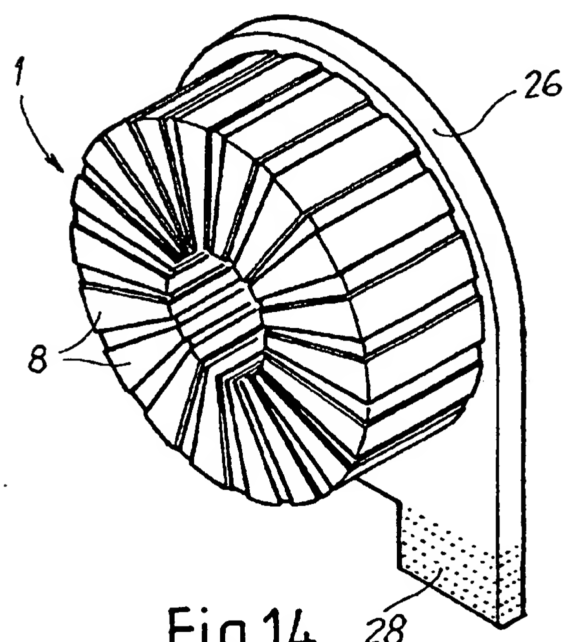


Fig.14

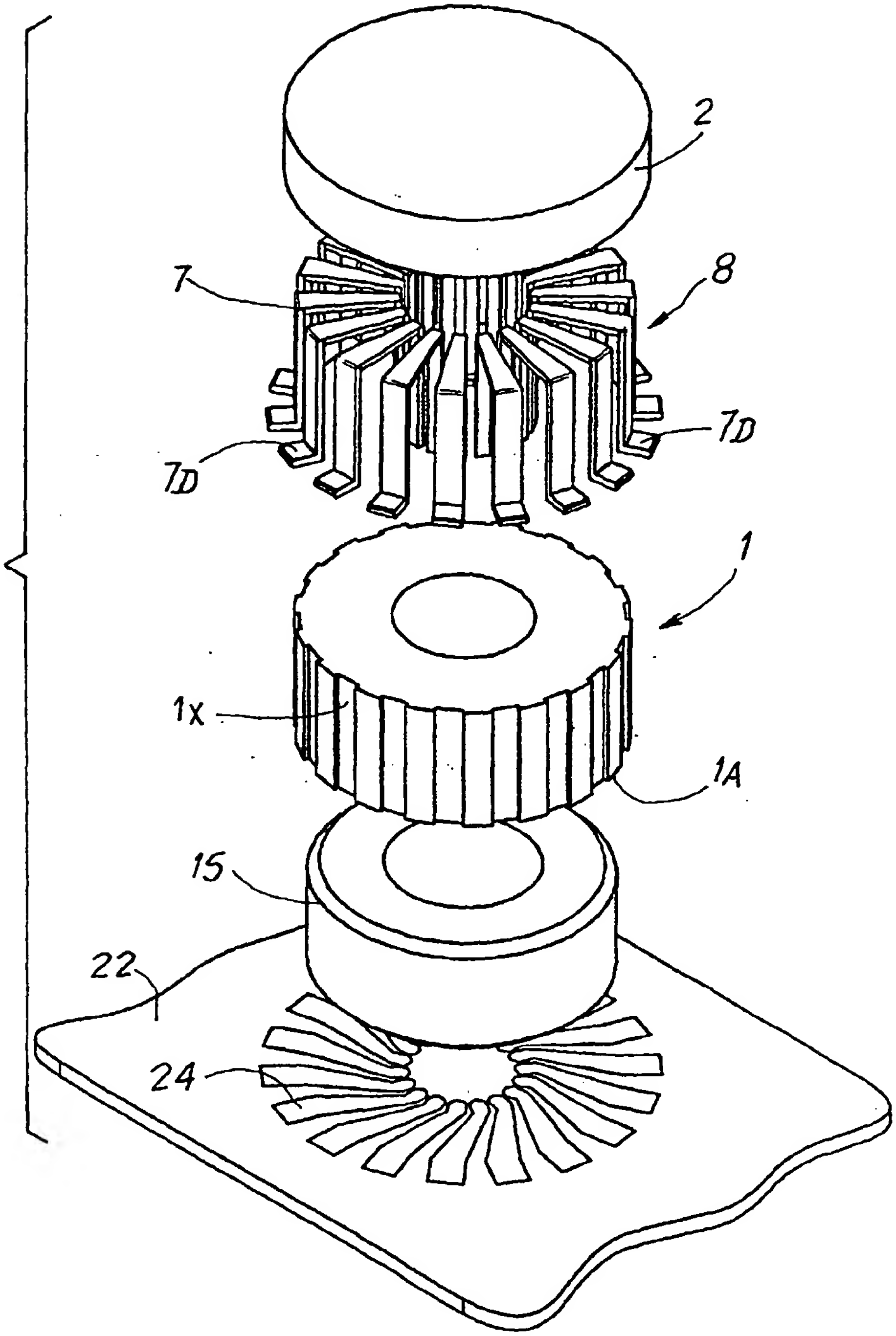


Fig.15

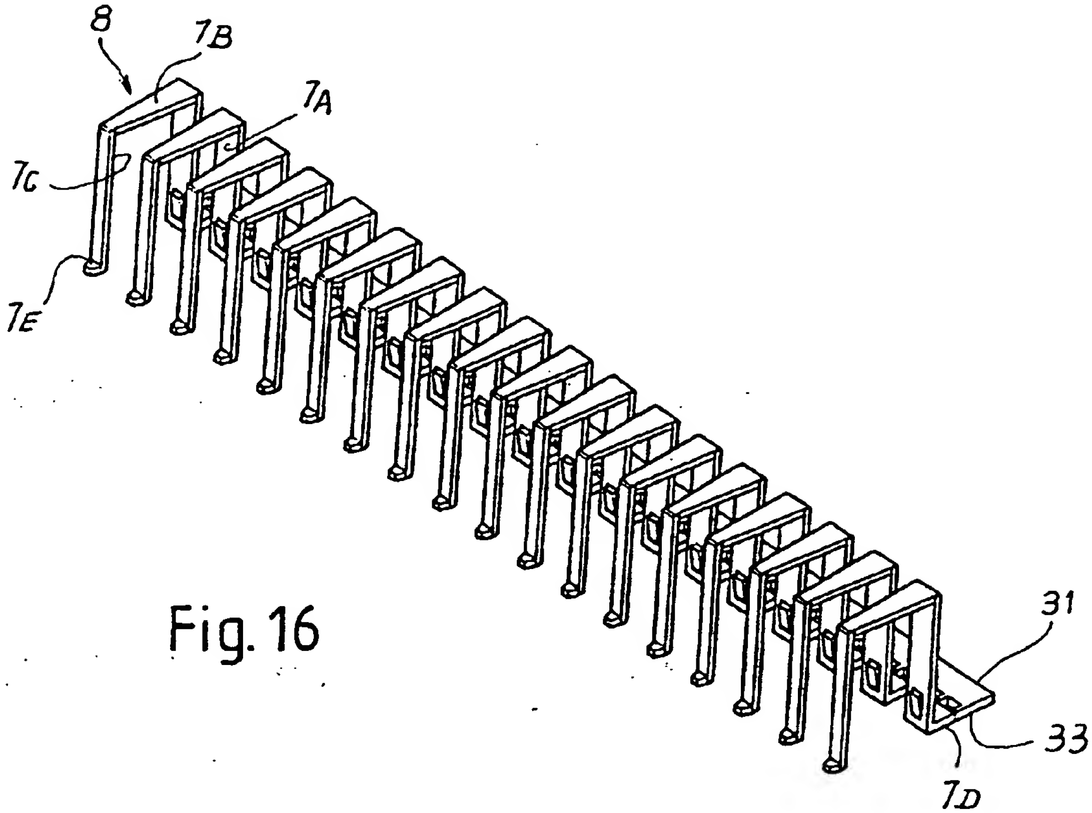


Fig. 16

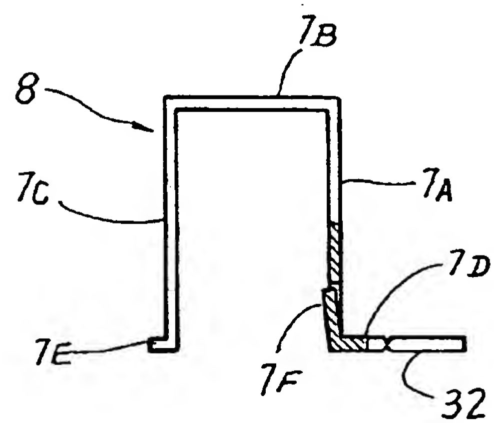
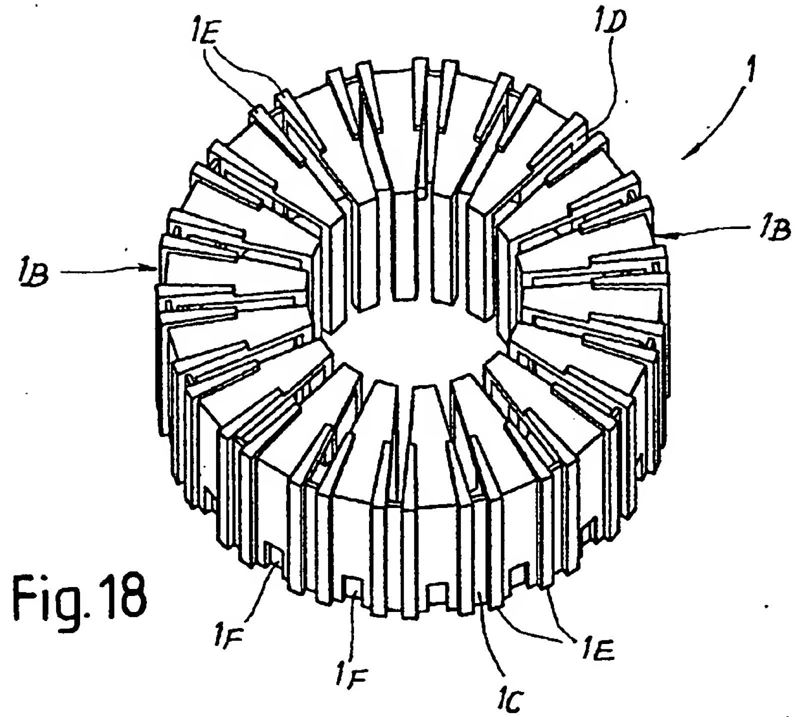


Fig.17



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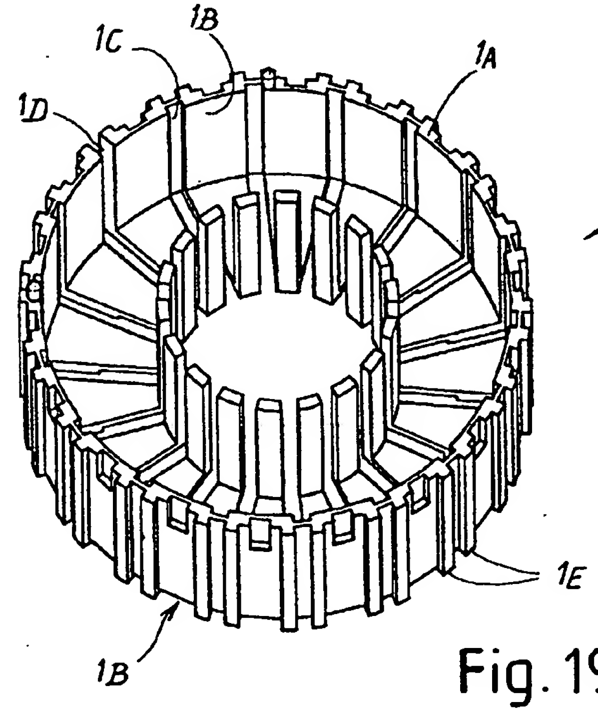

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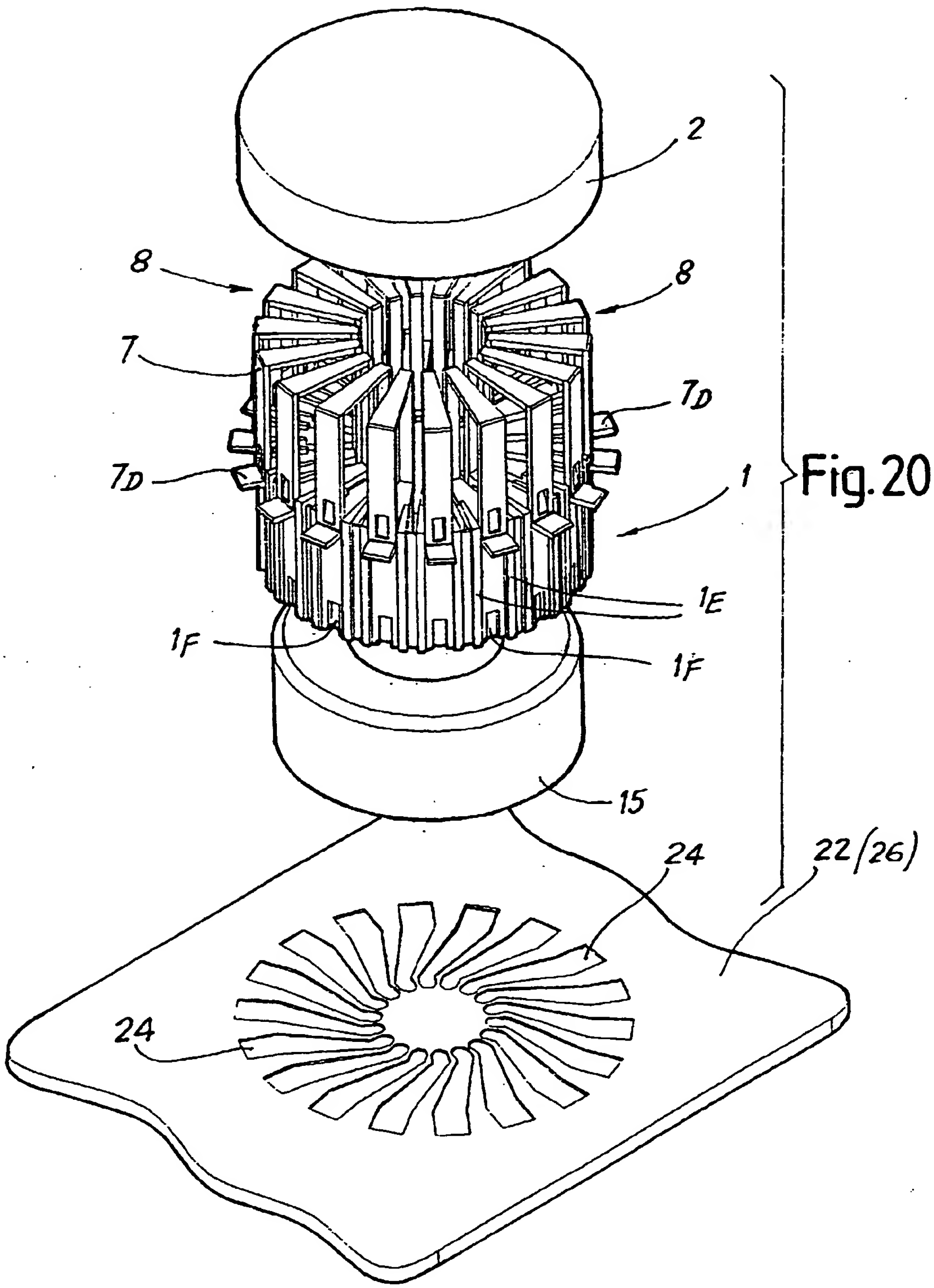
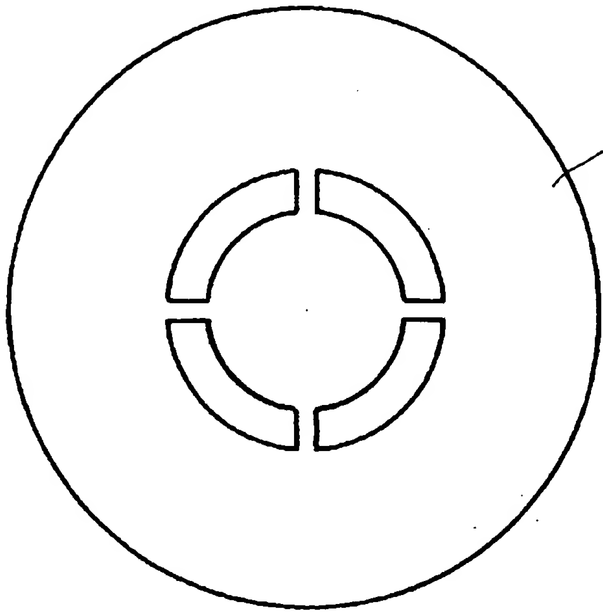


Fig.20



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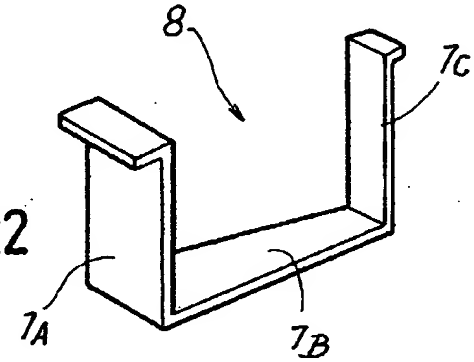

Fig. 22

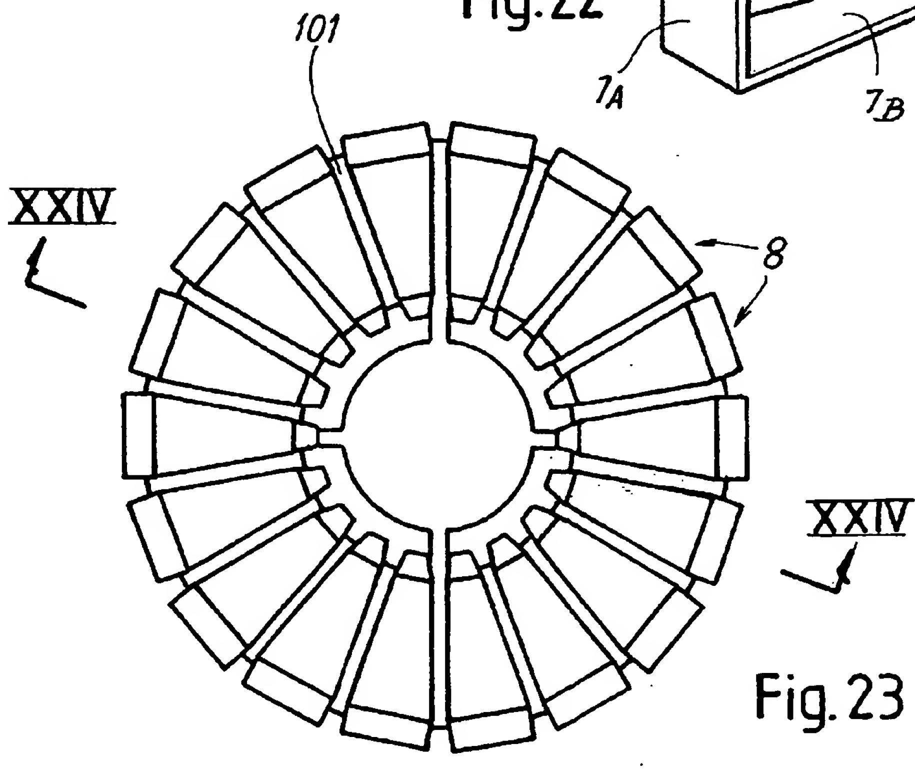

Fig. 23

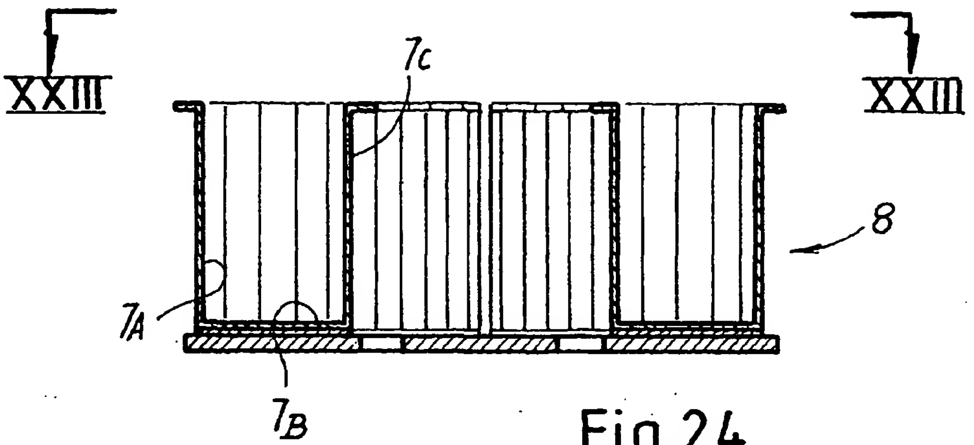

Fig. 24

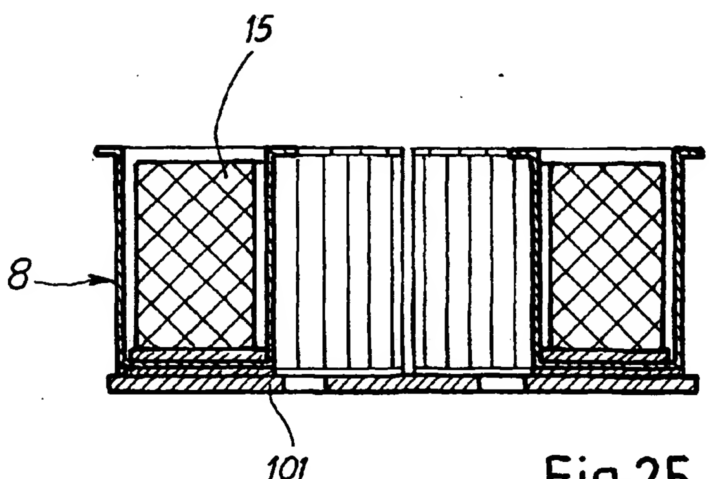

Fig. 25

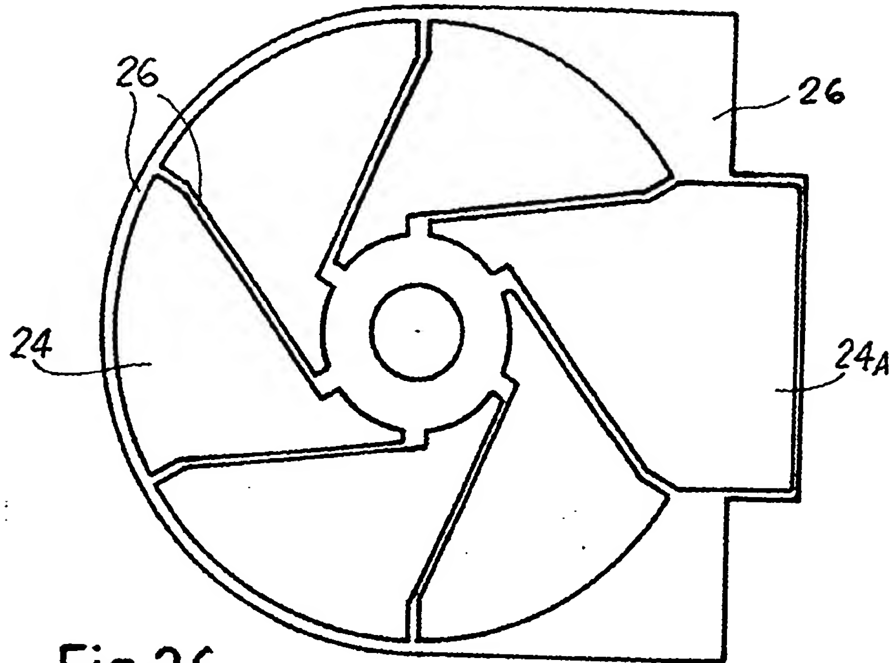

Fig.26

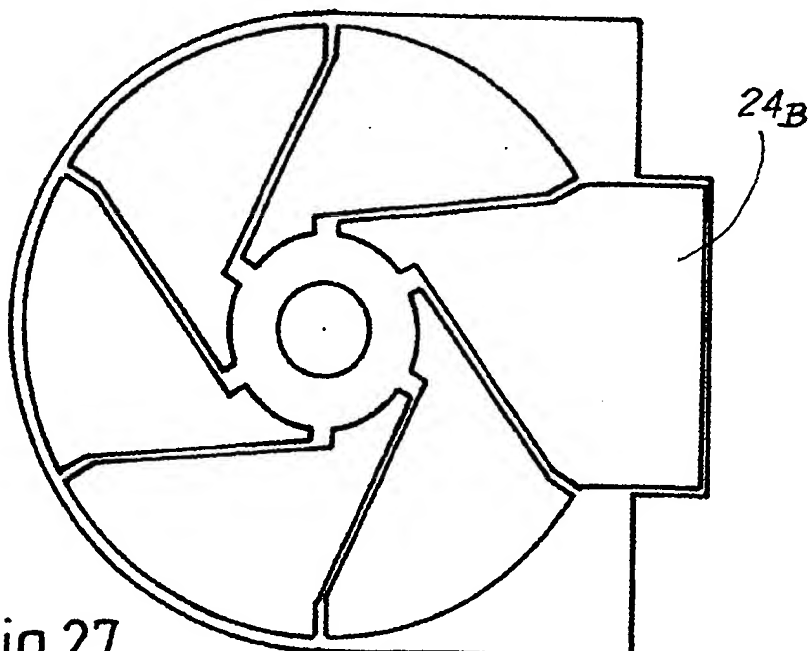

Fig.27

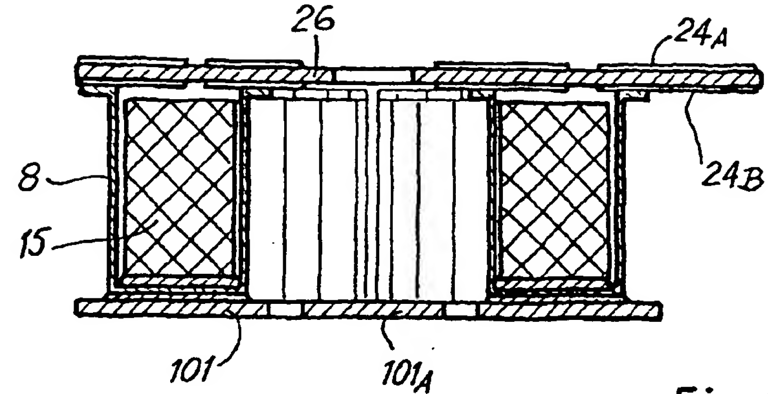

Fig. 28

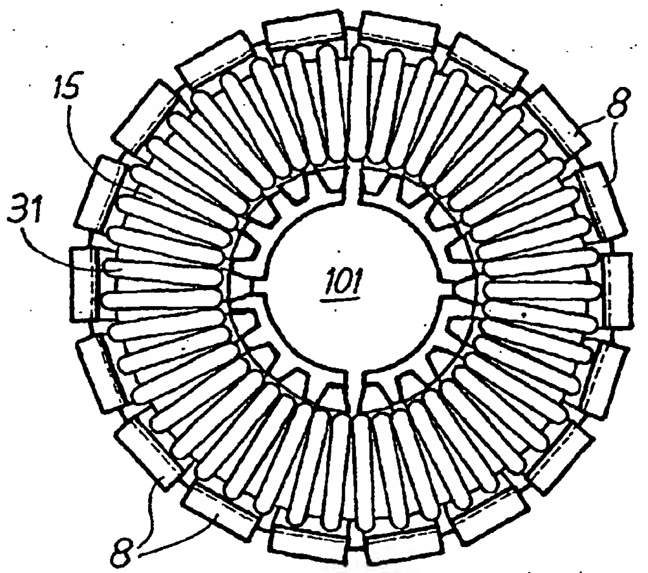

Fig.29

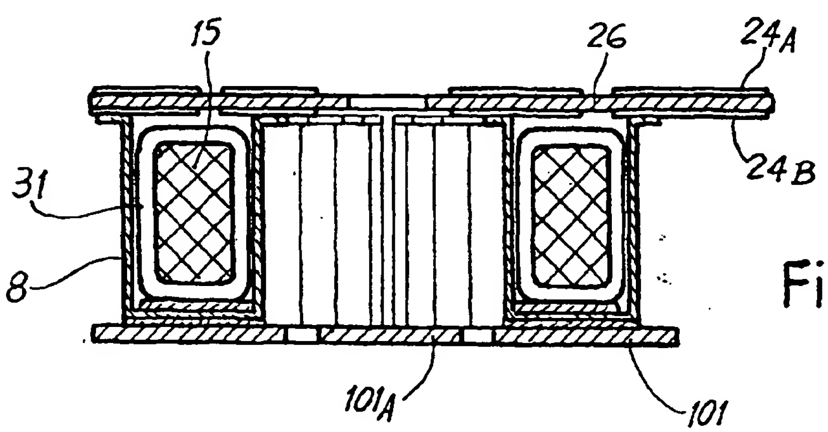

Fig.30

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0471

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 490 438 A (PHILIPS NV) 17 June 1992 (1992-06-17) * claims; figures *	1,2,4-6, 16-22, 25,36, 38,39	H01F27/28 H01F41/04
X	US 4 536 733 A (SHELLY RANDOLPH D) 20 August 1985 (1985-08-20) * abstract; figures *	1,17	
A	DE 35 22 740 A (BCL LICHTTECHNIK INH CLAUDIA C) 23 October 1986 (1986-10-23) * page 11, line 7 - page 12, column 4; figure 1 *	23,24,35	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 November 1999	Marti Almeda, R

CATEGORY OF CITED DOCUMENTS

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29-11-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0490438 A	17-06-1992	NL 9002753 A	01-07-1992
		DE 69112186 D	21-09-1995
		DE 69112186 T	04-04-1996
		JP 4340208 A	26-11-1992
		US 5214403 A	25-05-1993
US 4536733 A	20-08-1985	NONE	
DE 3522740 A	23-10-1986	NONE	

EPO FORM P0459

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